Early Journal Content on JSTOR, Free to Anyone in the World

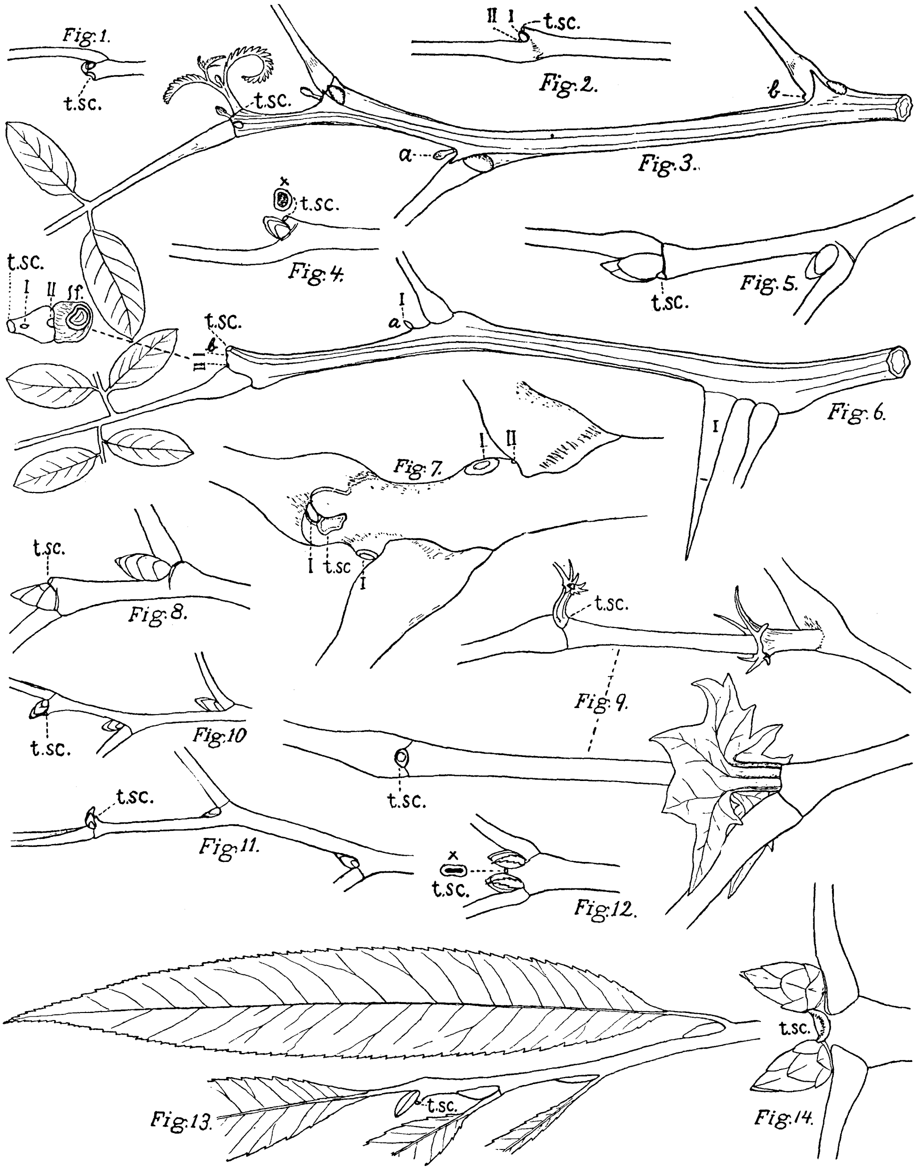
This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

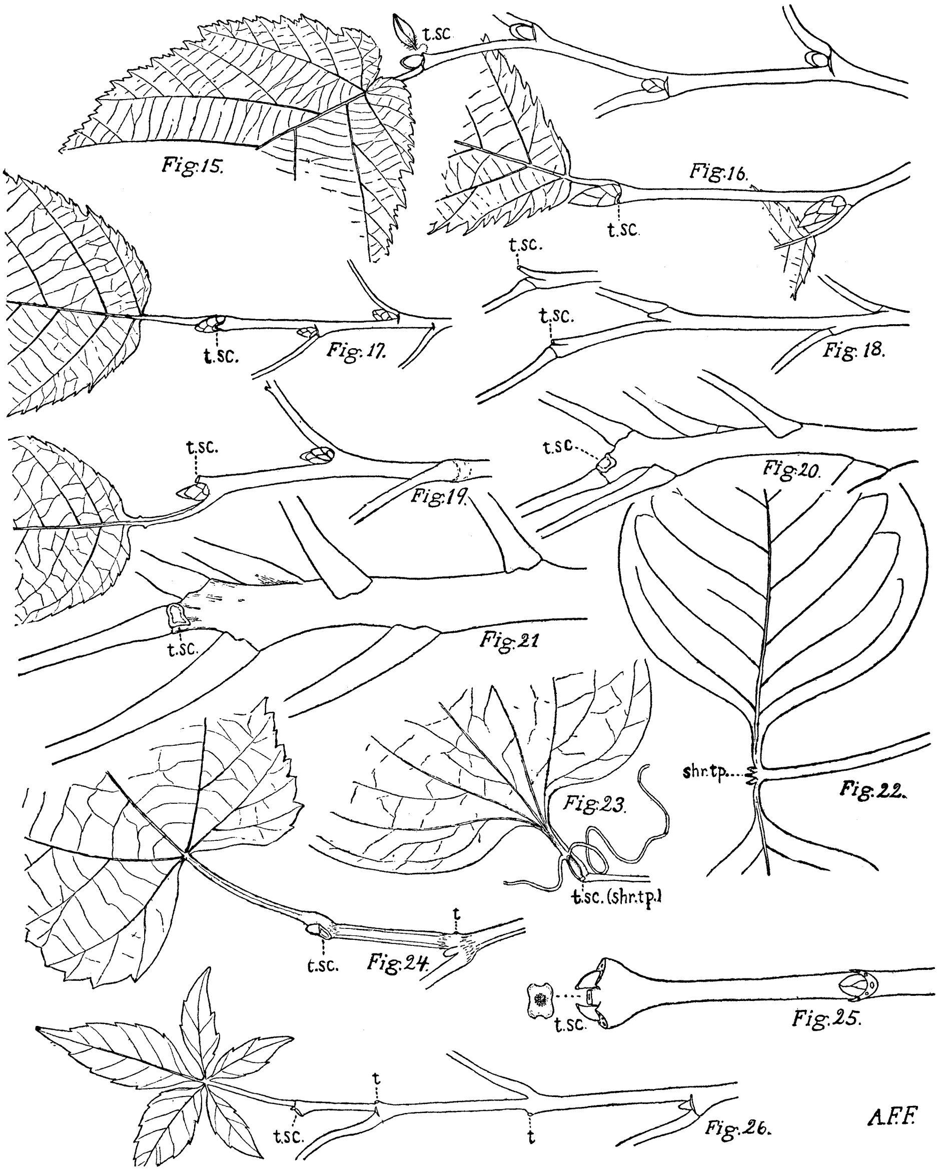
Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.



ON THE CASTING-OFF OF THE TIPS OF TWIGS.—A. F. FOERSTE.

BULLETIN OF THE TORREY BOTANICAL CLUB.—PLATE CXLVIII.


t.sc
Fig. 15.
Fig. 16.
t.sc.
t.sc.
t.sc.
Fig. 17.
t.sc.
Fig. 18.
t.sc.
t.sc.
Fig. 19.
Fig. 20.
t.sc.
Fig. 21
shr.tp.
Fig. 22.
Fig. 23.
t.sc. (shr.tp.)
t
t.sc.
Fig. 24.
t.sc.
Fig. 25.
t
t.sc.
t
Fig. 26.
A.F.F.

ON THE CASTING-OFF OF THE TIPS OF TWIGS.—A. F. FOERSTE.

plain the great nutritive value of clover hay. Indeed, bacteriologists are now beginning to wonder if it has not been through the agency of these micro-organisms that the large nitrate beds of the world have been deposited. The nitrate beds of Chili are vast in extent, and it has been already suggested that these beds owe their deposition to the agency of some microbes, to bacteria associated with higher plants which have grown in these localities in past ages. If so, we see even more forcibly that at the very foundation the life of the world is dependent on the action of bacteria.

WESLEYAN UNIVERSITY.

On the Casting-off of the Tips of Branches of Certain Trees.—Part II.

BY AUG. F. FOERSTE.

(PLATES CXLVII. AND CXLVIII.)

In "Gray's Structural and Systematic Botany," page 44, may be found the following passage:

"When a terminal bud is formed* this is commonly the strongest or among the stronger. But in many cases it habitually or commonly *fails to appear.*† In the Elm the bud axillary to the last leaf of the season takes its place. In the common Lilac a pair of buds, which were in the axils of the uppermost of the opposite leaves, seem to replace the terminal bud, which *seldom*† develops."

On page 49 are the following words:

"In other cases, on the contrary, the branches grow on *indefinitely* until arrested by the cold of autumn; . . . the later-formed upper portion most commonly perishing from the apex downward for a certain length *in the winter.*† The Rose and Raspberry, and, among trees, the *Sumac* and *Honey-Locust*, are *good illustrations of this sort.*"†

In the September (1892) number of this journal the writer had occasion to show that the reason why the terminal bud *fails to*

---

* Incidentally the author is chiefly referring to the scaly buds of ligneous plants.

† Not italicized in the original.

appear in some ligneous plants was because at an earlier date, before terminal scaly buds were formed, the tips of the branches had fallen off at well marked joints. This was shown to be the case not only in the Elm, but also in other species.

In the common Lilac the terminal scaly buds fail to appear, simply on account of the fact that at an early date the tips of the branches wither, though remaining more or less attached to the stem.

As regards the perishing from the apex downward for a certain length *in winter*, this is no doubt true of the Rose and the Raspberry; but in the case of the Sumac and Honey Locust it just as certainly is false, since in the case of both these plants the tips of the branches are cast off at well marked joints before the close of summer, as will be seen in the following paragraphs.

The preceding passages have not been quoted in a spirit of criticism, but in order to show that the subject of the casting-off of the tips of branches, although a common occurrence, has not yet received all the attention it deserves.

In the present paper it is desired to emphasize two facts, that this casting-off of tips occurs in widely different families, and that in certain minor groups of plants, or sections of families, the habit is common to many species, while in other groups scaly terminal buds are the rule. It is believed that the presence or absence of terminal scars on winter twigs has additional interest, since their existence may assist greatly in the determination of trees in winter, as suggested by the writer in another paper recently.

In the following notes, unless otherwise specified, the observations refer to plants growing in the vicinity of Dayton, O., the examinations and figures were all made during the first week of August.

Tilia Americana (Fig. 5). See, also, Fig. 6, Plate CXXXII., of this journal, showing the same species during its winter months. Fig. 7 of the same plate shows one of the very few tips of *Tilia platyphyllos*, still remaining attached to its branch during the last days of May, at Heidelberg, Germany.

Ptelea trifoliata (Fig. 20). The petioles are light green, the bark of the twigs is of an almost chocolate brown color. The terminal scar is roundly angulate, similar to that of *Rhus glabra* and *Gymnocladus dioica*. *Xanthoxylum Americanum* has terminal buds rising but little above the surface of the stem, and covered with a thick coating of short red hairs.

Ailanthus glandulosus was figured (Fig. 5) on Plate CXXXII. of this journal.

Ampelopsis quinquefolia (Fig. 26). This plant is a curious case of sympodial growth. After a node bearing a leaf but no tendril, there are quite normally two nodes bearing a leaf and also a tendril, then follows a node again without a tendril. The leaves have the appearance of being alternate, distichous. Where there is no tendril the leaf axil quite commonly contains a well developed scaly bud. Now it was a curious fact in all the observed cases that where the tips of the branches were absent, the scar belonged to that node where there should be no tendril. This is well worthy of note since in August many of the tendrils of this plant have fallen off and left scars, though these are much smaller than the terminal scars. In case of the grape it was very difficult to get satisfactory tips of branches, since these tips were still growing, or had been eaten off by animals. In a very few cases I noticed, as in *Ampelopsis*, a scar where the node should bear no tendril, and I have figured one of these (Fig. 24). *Celastrus scandens* in September showed terminal scars only on the shorter, stronger branches, but later, in November, almost all branches showed terminal scars.

Æsculus glabra (Fig. 14) and *Æsculus Hippocastanum* (Fig. 4 of Plate CXXXII.), will be discussed at the close of this paper. *Staphylea trifolia* (Fig 12, see also Fig. 3 of Plate CXXXII. of this journal), has a very peculiar terminal scar, owing to the fact that the uppermost pair of buds have so compressed the sides of the terminal scar as to very much decrease its diameter in one direction and to give it the form noticed in the figure. The central portion is depressed. The figure shows the stipules. Species of *Negundo* and *Acer* have terminal scaly buds.

Rhus glabra, (Fig. 21) has a roundly-angulate terminal scar. The fruited tips of this species remain on the plant all winter, dying back as far as the first leaf bud, as may be expected in the case of any fruited tip of a stem, which did not fall off after the seeds were ripened (as is usually the case). All branches not terminated with flower clusters, cast off their tips at well marked scars. *Rhus copallina* sheds a tip about 15 mm. long, consisting of three or four leaves with very hairy, strong petioles and very small and narrow, almost needle-like leaflets, 3–4 mm. long. *Rhus aromatica* (Fig. 18) casts off its leaves at a point a little above the base of the petiole; the portion remaining attached to the stem is rather appressed, and hides the subtended bud during its earlier development. The terminal scar is found at the end of a round, rod-like tip, which may be produced quite a distance beyond the point of attachment of the uppermost remaining leaf. *Rhus radicans* has terminal scaly buds.

Robinia Pseudacacia (Fig. 3). The terminal scar is somewhat irregular, owing to the angulate character of the branches. In consequence of shrinking, subsequent to the falling off of the tip, the terminal scar is quite puckered up, as is also the case with *Gleditschia triacanthos*. The figure shows the top of the branch still attached, but withering, and the position of the scar is already indicated by the fact that the yellow color of the withering part stops abruptly at a plane bounding the green portion further down which is to remain. Even before the slightest withering has commenced, it is already possible to see at what node the plane of separation is to be by the fact that whereas the last leaf of the remaining portion develops rapidly into a full sized leaf, the next succeeding leaf which is to fall off shows retarded growth at a very early stage, while the tip is still green.

During the first week of August all the tips of the higher branches had fallen off. This was true also of the lower branches, where the tree was fully developed. Occasionally, however, the lower branches were more vigorous, and were still continuing growth, or were preparing to also cast off their tips. From one of these lower branches the figure was taken. In young growth, or in fresh shoots from cut down stumps, the tips of the branches were often present in the middle of August, but in the middle of September all the tips seemed to be shed. In the axils of the leaves are little raised circular scars, left by axillary buds which are cast off at a very early stage of their development. In the figure these are shown in all except the lowest axil. In very vigorous shoots these buds develop into leafy branches during the same season. It is especially to be noted that the lower branches of a tree are often still growing after the tips of all the upper branches have been cast off. *Gleditschia triacanthos* (Fig. 6) shows all the features just noted of *Robinia* The only bud which is visible in the axil of the leaves is extra-axillary, being situated a short distance above the axil. This bud is cast off as a rule, at an early stage, or on very vigorous branches, develops into a leafy branch during the same season. The extra-axillary compound thorn of this tree is morphologically equivalent to these buds. As a rule the thorns are developed chiefly along the middle portion of each year's growth, but occasionally the thorns occur even at the uppermost axils destined to remain. In that case the terminal scar is formed just above the last thorn. The visible buds therefore, of both *Robinia* and *Gleditschia*, (unless they be represented by thorns or develop into leaf branches the same season) are cast off. The buds which continue the growth of the branch are hidden away beneath the petioles of the leaves at this time of the year, so that the cast off buds are in reality the uppermost ones of a series of a superposed bud. *Gymnocladus dioica*, (Fig. 7) has a roundly angulate terminal scar. The superposed buds are sunken in pits, and often drop out. This is especially true of the largest bud in the axil of the last remaining leaf, this bud being the uppermost one of its series, and hence, lying next to the terminal scar. *Cercis Canadensis*, (Fig. 2) has a little rounded terminal scar. The last remaining leaf has a petiole placing itself in line with the stem, as is quite commonly the case where the phyllotaxy is alternate and distichous. A glance at the figures on the accompanying plates will readily show this. It is not uncommon to find more than one bud even in the last remaining axil, and the larger of these superposed buds, the upper one of the series, lies then against the terminal scar.

Prunus Americana (Fig. 19) shows very distinct terminal scars. It is more usual for ligneous Rosaceæ to have terminal scaly buds, so the present exception is worth noting.

Calycanthus floridus (Fig. 25) has well marked terminal scars.

It was impossible to determine satisfactorily whether *Sambucus Canadensis* ever had terminal scars or not. In the early days of August many branches were still growing. Later in the year some branches were found terminated by scars, but these seemed to be caused by the breaking off of the fruited flower clusters at the ends of the branches. *Lonicera flava* (Fig. 22) has the tips withering away, but not falling off at a well marked scar. The dried up tips may be seen between the upper pair of leaf buds.

Cephalanthus occidentalis has its branches almost invariably terminated by inflorescences, a part of which have never developed into flowers. The few tips with flower buds show shriveled-up leaves at the ends of stems, drying back a little, thus giving rise to sympodial growth.

Catalpa speciosa, Warder, was figured (Figs. 1, 2) on Plate CXXXII. of this journal. During the early days of August most of the tips had been cast off; here and there the very short, shriveled remains embracing only a few nodes were still attached to the stem. The tips of a few of the lower branches were growing vigorously and did not lose their tips until later during the month. It was impossible to get satisfactory specimens from *Tecoma radicans*. Many branches were still growing when examined. Where there were terminal scars it was often possible to ascribe these to the falling of the flower clusters, where fruiting had not set in. One case was found where apparently the leafy tips of a branch had fallen off, but the case was not altogether satisfactory.

Diospyros Virginiana, with its shriveled-up tip, was figured (Fig. 9) on Plate CXXXII. of this journal. Terminal scars are also common.

Ulmus Americana (Fig. 10 and Fig. 8 of Plate CXXXII. of this journal) and Ulmus fulva (Fig. 8) both lose the tips of their branches, indeed, quite early in the year. *Ulmus campestris* was observed at Heidelberg, Germany, to have lost about one-third of its tips during the last week of May, although the future plane of separation was becoming visible in the remainder. *Celtis occidentalis* (Fig. 11) also shows the terminal scar. A little feature was noted which will well serve to readily distinguish this tree in winter time, when other aids are not at hand. The scaly bud in the axil of the last remaining leaf is quite strongly bent away from its leaf and recurved over the terminal scar, the bud itself giving evidence of this curvature. The appressed nature of the remaining buds is also worthy of note.

It has already been remarked here several times that the lower branches of trees seem to be more vigorous and frequently are still growing when all the upper branches have already cast off their tips. In the case of *Celtis occidentalis* this found expression in another way. A number of trees were found early in August, on the Germantown road, on the way to the Soldiers' Home, which had lost all the tips of this year's normally produced branches. But in the case of many of the lower branches the uppermost scaly bud had not waited till next year for its development, but had renewed growth during the same season. In August the tips of even this second crop of branches had been already cast off in many cases. But here and there the tips were still attached, though turning yellow in color and giving evidence of the location of the future plane of separation. The tips included only a few nodes, and were 4-6 mm. long.

Morus rubra (Fig. 4) has well developed terminal scars, with a depressed central portion. The milky juice of the bark will also serve to distinguish the species when the leaves are gone. In winter the twigs of *Tilia* have a similar appearance, but its terminal scar has no depressed centre.

Ioxylon pomiferum (Fig. 1) was found during the first days of August to have cast the tips of all the more mature branches. But where the hedges had been cut and a fresh crop of branches had appeared many branches were still growing, and the tips were therefore vigorous. Later in the year this younger crop of branches also lost its tips. In the more mature trees all the branches had lost their tips in September.

Platanus occidentalis (Fig. 9) is one of the more interesting of trees which shed the tips of their branches, owing to the fact that the lower part of the connate stipules forms a sheath embracing the stem. That portion of the tip which is destined to fall off, ceases growth quite soon and withers; being surrounded by the sheath of the stipules, it may be either entirely included within the same or it may project a little from the sheath (Fig. A). After a time both the tip of the branch and the surrounding stipular sheath fall off and a terminal scar is left (Fig. B). Both stages were visible during the first week of August. The uppermost subpetiolar bud continues the growth of the branch; this is, however, an axillary bud. It does not become visible until the leaves of that part of the stem which remains have fallen off.

Corylus Americana (Fig. 15) casts off its tips while they are still small. One of these tips is here figured. The axillary scaly buds are small and oval or rounded, showing but three or four scales exteriorly; the base of the leaves is distinctly and strongly heart shaped. *Ostrya Virginica* (Fig. 16) has long, pointed axillary scaly buds, showing six or more scales exteriorly. The petioles about equal the buds in length. The lower half of the leaves is wedge-shaped, with a narrow base. The tip of the leaves is long, almost awl-pointed. *Carpinus Virginiana* (Fig. 17) has ovate obtuse scaly axillary buds. The petiole of the leaves is more than three times as long as the subtended scaly buds. The lower half of the leaves is much less evidently wedge-shaped, and the base is more rounded than in the last species. The short, almost abruptly pointed tip of the leaves is quite a useful distinguishing feature. In all three species just enumerated, the terminal scar is very tiny, and often difficult to find. Their leaves are alternate, and distichous. In the scaly buds this phyllotaxy is obscured by the fact that most of the scales represent stipules, and hence occur in pairs; on this account the distichous arrangement of the elements of the bud cannot be readily made out. This characteristic will serve to distinguish these genera from the ordinary distichous plants during winter months. Species of *Quercus*, *Castanea* and *Fagus* show terminal scaly buds.

Some species of *Salix* show terminal scars (Fig. 13) Observed species of *Populus* have terminal scaly buds.

Some species of *Smilax* show at times a short shriveled up remnant of the tip of the branches, at others a terminal scar (Fig. 23).

The best cases of groups of plants casting off the tips of their branches quite generally are the Leguminosæ, Urticaceæ, the Carpineæ among Cupuliferæ, perhaps the Bignoniaceæ, and to a lesser degree the genera *Tilia*, *Staphylea* and *Aesculus*, the sections *Sumac* and *Lobadium of Rhus*, possibly the Vitaceæ in part, and apparently a fair proportion of the species of the genus *Salix*.

The preceding list includes 23 genera in which the casting off of the tips has been noted with certainty. The list is by no means complete for the northeastern United States, but includes chiefly such plants as the writer could find growing near Dayton, Ohio, and use for the purposes of illustration. They certainly indicate that the method of securing determinate growth by the casting off of the tips of branches (usually early in the summer, and quite generally before the first of August) is a fairly common and normal one, and as such is worthy of mention in discussions of the habits of trees.

One of the most interesting features about the growth of trees is the shortness of the period of development of the twigs of the year. The winter months at Bainbridge, in Georgia, have been unusually severe this year (1893), so that the vegetation was decidedly backward. At the beginning of March very few leaves had made their appearance on trees. At the close of this month quite a number had already developed their terminal scaly buds, or had begun to cast off the tips of their branches. In some cases the terminal buds were seen in but little more than two weeks after the leaves began to appear. The following notes were taken at the end of March: *Æsculus Pavia* had well formed terminal buds; the exterior pair of scales of these buds show a leaf-like tip at first, but this falls off at an early date at a scar having about the level of the top of the bud at this time. Careful search for terminal scars did not reveal any which could not be referred to the casting off of flower peduncles after the period of flowering. *Æ. glabra* is probably in the same case, and it is equally likely that the supposed terminal scars of *Æsculus Hippocastanum* are caused by the falling off of flower peduncles, although I was trying to guard against this error at the time the first part of this paper was written.

Enonymus Americanus in one case had developed the internodes of the scaly bud so much as to elevate the innermost scales 120 mm. above the base of the former winter bud. The leafy portion was 300 mm. long and consisted of 6 pairs of leaves. The terminal bud was already formed. *Acer saccharinum*, *Hamamelis Virginica*, *Cornus florida* and *Viburnum prunifolium* had already terminal scaly buds. The less vigorous branches of *Juglans nigra* had ceased producing new leaves. Several species of oaks had already developed far enough to show terminal buds on many trees while on others the leaves had not yet begun to make their appearance.

Quercus nigra furnished a good example of a plant which has most of the nodes for next year's growth already indicated in the bud. The stipules of 14 leaves showed distinctly that they had formed part of the scaly bud during the winter, and this was, not improbably, also true of most of the stipules farther up. It is evident therefore, that the growth of the new crop of branches was little more than the development of the leaves whose position was already determined in the winter bud. Many beeches, *Fagus, ferruginea,* had formed their terminal buds, although these were still very small and did not at all resemble the winter buds.

Regarding the early development of terminal scaly buds it may be observed that at the time of their detection they are far from being fully developed, and they are often still very dissimilar from their fully grown winter form. Moreover at the time of their first detection the internodes of the new year's twigs have not yet finished their growth, so that the terminal bud is already indicated at a time when the full length of the twig has not yet been attained.

Vaccinium tenellum at the end of March was shedding the tiny tips of the branches consisting of two or three very minute leaves. *Carpinus Virginiana* was shedding tips about 3 mm. long, sometimes longer, of which the leaf elements could be recognized more readily. Although the old branches of *Leucothoe axillaris* gave evidence that they had shed their tips during the preceding year, the new crop of branches had scarcely started in March.

Both methods of terminating the growth of the year, that by means of the formation of terminal scaly buds, and that of casting off the tips of branches, are employed very early in the year, as just seen. When, however, a ligneous plant does not terminate its growth until late in the year, the casting off of the tips of the branches seems to be the rule, where killing back of the tips does not obtain. It would be interesting to learn how many ligneous plants develop terminal scaly buds after the first of June, for example, in a more northern climate. It is believed that the casting off of the tips of branches would be much more common after that date.

Description of Plates CXLVII. and CXLVIII.

Fig. 1. *Ioxylon pomiferum;* with a rounded protuberance at the side of the bud.

Fig. 2. *Cercis Canadensis*; with superposed buds in the last axil.

Fig. 3. *Robinia Pseudacacia;* with the tip destined to be cast off still in position, but with the future plane of separation already indicated; at *a* is the upper one of the series of superposed buds, destined to be cast off, and to leave a small protuberance as at *b*.

Fig. 4. *Morus rubra;* with magnified view of the terminal scar, with a depressed centre.

Fig. 5. *Tilia Americana.*

Fig. 6. *Gleditschia triacanthos;* at *a*, is the upper one of the series of superposed buds destined to be cast off, as at *b;* the remaining buds of the series are usually all sub-petiolar; in the axil of the last remaining leaf, the figure shows the next lower bud, just peeping from beneath the base of the petiole; an upper view of this portion of the branch, somewhat enlarged, is added. The thorn is the equivalent of the upper superposed bud which usually drops off before the close of August.

Fig. 7. *Gymnocladus dioica*; with only the uppermost of the superposed buds of the last remaining axil visible in the figure.

Fig. 8. *Ulmus fulva.*

Fig. 9. *Platanus occidentalis*: two figures; the upper one still retaining the shriveled up tip of the branch, with the enclosing stipules belonging to the last remaining leaf. In the lower figure these have been cast off.

Fig. 10. *Ulmus Americana.*

Fig. 11. *Celtis occidentalis;* the upper-axillary bud strongly recurved, a distintinguishing feature of this genus.

Fig. 12. *Staphylea trifolia;* showing the stipules belonging to the upper pair of remaining leaves; also a magnified end view of the terminal scar.

Fig. 13. *Salix.*

Fig. 14. *Æsculus glabra;* when the end of the twig does not fall away, and when there has been no flower cluster, a scaly bud terminates the stem.

Fig. 15. *Corylus Americana;* with a drawing of the small tip which has been cast off.

Fig. 16. *Ostrya Virginica.*

Fig. 17. *Carpinus Virginiana.*

Fig. 18. *Rhus aromatica;* two figures. The branch in most cases is terminated by a flowering catkin destined to blossom next year.

Fig. 19. *Prunus Americana.*

Fig. 20. *Ptelea trifoliata.*

Fig. 21 *Rhus glabra.* The branches are often terminated by the remnants of last season's flower clusters.

Fig. 22. *Lonicera flava,* with the shriveled up tip of the branch adhering.

Fig. 23. *Smilax hispida;* with a terminal scar. Often the tip of the branches simply shrivels up, and a part or all remains attached to the remainder of the stem.

Fig. 24. *Vitis.*

Fig. 25. *Calycanthus floridus.*

Fig. 26. *Ampelopsis quinquefolia.*

In all the figures *t. sc.* indicates the terminal scar; *shr. tp.*, the shriveled tips remaining in case of some plants, and *t*, the scar left by the casting off of the tendrils.

A new Fossil Palm from the Cretaceous Formation at Glen Cove, Long Island.

BY ARTHUR HOLLICK.

(PLATE CXLIX.)

For some years past the writer has been engaged in the study of the Cretaceous formation of this vicinity, particularly on Staten and Long Islands, and a considerable amount of material representing the fossil flora of that formation has been collected. The specimens from Staten Island have already been described, * —those from Long Island it is hoped to describe in full in the near future, but in the meantime it has been thought best to publish in advance the accompanying description and plate.

Probably the greatest surprise experienced in the study of the above mentioned material was in the discovery of an undoubted palm leaf. The significance of this discovery from the geological standpoint need not here receive more than brief mention, as this will be fully discussed elsewhere. It is sufficient to say that the other fossil leaves associated with it show the geological horizon to be the equivalent of the Amboy clays of New Jersey and other middle Cretaceous strata in America and Europe, from none of which have palms been definitely recorded. In fact the presence of palms in lower and middle Cretaceous strata is so rare, if not entirely wanting, that this discovery seems to warrant special attention. They appear in great abundance in upper Cretaceous and Tertiary rocks, and their sudden appearance without any apparent ancestry has always been a puzzle. The significance of the find may therefore be appreciated.

---

* Trans. N. Y. Acad. Sci. xi. 96–103, Plates i.–iv. and xii. 1–12, Plates i.–iv.